

# Study on the Black Spots of Highway of India: A Review

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**Abstract:** India is one of the fastest developing nations in the world, thus resulting in more buying capacity for its citizens. There is an explosion of vehicles on Indian highways which has surged by more than 400 percent from 2001 to 2013 i.e. in 12 years comparing it to National highways which merely has grown by 133 percent, thus resulting in congestion and increase of accident rates in India. Black spots are being declared throughout the country in order to achieve the aim of reduction of accident by 50 percent till 2020. Middle-income countries own about 52 percent of the world's vehicle but they account for more than 88 percent of the world's road traffic fatalities. By this rate of growth the fatal accidents are going to be the 5th largest cause of accident in the world by 2020. Pedestrians, Cyclist and Motorbikes together form around 57 percent of death rates happening on the roads of the world, out of which persons in the age group of 15 to 44 years account for more than 60 percent of world's total fatal accident rates. Literature Review has been carried out showing the scenario of accidents happening on different highways of India along with its causes and solutions.

**IndexTerms - Black Spots, Accident, Fatal Accidents, Pedestrian and Cyclist, Geometric deficiencies causing accidents.**

## I. INTRODUCTION

Traffic on the highways of India has seen a dramatic rise. Passenger vehicles, commercial vehicles, three wheelers and two wheelers has grown by 34.8%, 37.44%, 27% and 24% respectively from year 2001-2013, thus there is a gross increase of 400% in traffic[1]. Comparing it to the National highway has merely grown 133% from the year 2000-01 to 2011-12 [2]. Clearly depicting the state where the highways are being choked because it is not able to cope up with the growth rate of traffic. Accident surged by 2.5% out of which 4.6% were fatal accidents from 2014 to 2015 [3]. In order to reduce the accident rates to 50% by 2020 as pledged by government of India, the locations with high number of fatal accidents rates are being named as "Black spot". The road accident black spot is a stretch of national highway or other category of road (SH/MDR/Other roads) of about 500 m in length in which either 5 road accidents (in all three years put together involving fatalities / grievous injuries) took place during the last 3 calendar years or 10 fatalities (in all three years put together) took place during the last 3 calendar years may be strictly be followed [4]. Pedestrians followed by two wheelers are the major part being affected by accidents. The data collected by the police station is not in the proper format as recommended by IRC: 53-2012 of government of India, thus it is need of the hour to collect the data in a proper format and analyse it considering the maximum possible reasons of the accidents. The police records mostly show either drunken driving or over speeding as the major cause of fatal accidents . But due to lack of engineering vision among the police fraternity the technical aspects are often overlooked. Thus studies need to be conducted on the available data considering the engineering problems like geometric design deficiencies, pavement surface defects e.g. pot holes etc, improper lightening, non availability of pedestrian paths or cycle tracks etc.

## II. SCENARIO IN ABROAD AND INDIA

Fatal accidents per 100,000 people in the world in the year 2015 shows that Denmark , Israel, Singapore and United Kingdom has the least death rate of 3 while Russian federation has the highest rate of 19 followed by India having 11 and United States of America having 10[3]. A picture is depicted here that it not only the developing nation but the developed nations are also facing the problem of fatal accidents. Middle-income countries own about 52 percent of the world's vehicle but this vehicular group account for more than 88 percent of the world's road traffic fatalities [5]. By this rate of growth the fatal accidents are going to be the 5th largest cause of accident in the world by 2020. For accident analysis the world has been divided in to six regions i.e. African Region, Eastern Mediterian Region (Cyprus, Greece, Lebanon, Syria, and Egypt etc), Western Pacific Region (Australia, Cambodia, China, and Japan etc), South East Asia Region (Brunei, Cambodia, Indonesia, Singapore, and Thailand etc.), Regions of America (USA, Canada, and Mexico), European Region (UK, France, Germany etc). The order of region mentioned above is the decreasing order in which the African region has the highest death rate due to accident amounting to 24.1 per 100,000 population while it is least in European region valued to 10.3[6]. Pedestrians and Cyclist and motorbikes together forms around 57 percent of death rates happening on the roads of the world out of which Persons in the age group of 15 to 44 years accounts for more than sixty percent of world's total fatal accident rates [6]. In India Pedestrians, Cyclist and 2-3 wheel vehicles account for more than 45% of fatal accidents on the highways. From 2001 to 2015 death rate per 100,000 populations has increased from 8 to 11.7 i.e. around 46% rises [3]. 400 deaths takes place every day on India roads which leads to loss of 17 lives every hour. Delhi has the highest number of fatal accidents in the country. Drunken driving and over speeding by the vehicles are found to the major cause of deaths happening in India and mostly it is being happening at the junctions where two or more highways meet with each other [3].

## III. REMEDIAL MEASURES SUGGESTED AND IMPLIMENTED

Pedestrians and cyclist which forms the part of slow moving objects on and around existing road section can be protected by reducing the urban speed to 50 km/h. In United Kingdom 30 km/h zones in suburban area have been imposed which resulted in reduction of 67% accidents with child pedestrians [6]. Strict Laws shall be made on drink and drive laws by restricting the BAC (Blood Alcohol Content) limit to 0.03g/dl (India). Injuries to head and neck forms the major factor causing the death thus a helmet standard specific to the given environmental condition must be made according to the country's economy. Safety of passengers against fatal accident in four wheelers like cars can be improved by 40% by enforcing the strict law of wearing seat belts in the vehicles. Similarly infants and child from different age group needs to be protected while travelling in four wheelers. Similar to seat

belt use for adults, children needs child restraint for example ISOFIX system which needs to be implemented strongly in low and middle income countries to protect them from fatal injuries [6]. In the past decade mobile phone technology has made an immense progress to such an extent that in the year 2013 mobile phone are sent in space for collecting the data[7]. Driver distraction due to smart phone is rising rapidly thus it is predicted that it is going to become one of the major factor causing the fatal accidents. Strict laws have been implemented in all major countries already to restrict the use of smart phones/phones while driving. Non motorized vehicles on the highway like cycle and pedestrians are neglected while designing a highway or a road. In the past decade concerns towards environment has been shown greatly both by developed and developing nations thus in order to achieve it people are being encouraged to travel by cycle, use of public transport or by foot but without providing them with a safe path to travel in many instances. Thus it is a need of the hour to make special paths/lanes so that commuters can commute their journey safely. Public transport should be made fast and comfortable as per the environmental condition so that commuters are encouraged to use this system thus saving the environment around them like in Ahemdabad in India BRTS (Bus Rapid Transport System) has helped in reducing the accidents and decongestion of the roads in the city. At last vehicle safety norms shall be ensured based on New Car Assessment Programme test (NCAP Test) in order to ensure the safety of the drive and the passengers [6].

#### IV. LITERATURE REVIEW

Naidu et al. [8], has carried out the study of Black spots on NH-5 in the city of Vishakhapatnam (India). The data has been collected from police station situated on the National Highway. Targeting and ranking black spot method is used which is based on number of accidents occurring at locations considering factors like severity of accidents, condition of pavement and type of accidents. Spot speed study method is also deployed in order to determine vehicle highest speed on the highway and comparing it with the design speed thus in order to implement measures to control speed and avoiding the accidents. Accident analysis has been carried out based on following factors:

1. Daily variation of accidents
2. Timely variation of accidents
3. Gender wise analysis
4. Age limit variation of accidents
5. Monthly variation of accidents.

Remedial measures suggested are :

- I. Providing pedestrian paths as per IRC: 93
- II. Railing in between the medians.
- III. Maintenance of road furniture should be carried out in a planned way.
- IV. Providing missing traffic lights and sign boards.
- V. Changing the road gradient to the desired level.

Ashokbhai and Jain [9], has collected from Zonal Police from 2009-13 and on the basis of that data the spots causing the maximum number of accidents are identified and top 5 black spots are listed down. Inventory survey was conducted on the black spots considering the number of fatal major injury and minor injury accidents. The paper conclude that the accidents are happening due to poor road geometrics like absence of footpath, service lane /parking lane , zebra crossing , traffic signals.

Singh and Suman [10], collected data in two forms i.e. from police station in the form of FIR's and Volume data collected from PWD. Analysis has been carried out considering annual variation in accident, monthly variation in accidents, annual variation in fatalities, injury and accidents. Also Volume study has been carried out. Accident prediction model was created and it is concluded that the rate of accidents are more in the month of July(Rainy season) due to fast deteoration of shoulders and in January due to foggy weather. The accident rate of heavy commercial vehicle is more compared to the other motor vehicles lying on the highway.

Jadhav et al. [11], collected data from police station (2011-15). Identification of black spot has been carried out based on Critical crash rate factor method in which RMV (Rate per 100 million vehicle kilometres is determined using the following expression:  $RMV = A \times 100,000,000 / VT$  A= No. of crashes, total at the study location during a given period; VT= vehicle kilometres of travel during the given period= $ADT \times (\text{No. of days in study period}) \times (\text{No. of years}) \times (\text{length of road segment})$ ). Analysis has been carried out considering daily variation of accident, Timely variation of accident, gender wise analysis, and vehicle wise distribution and age wise analysis. It is concluded that maximum crash rate happen between the month of August to December and in rainy season of July. Accidents happen due to improper lane marking, missing of speed breakers and manholes.

In a study by Swetha and Parsad [12], accident data has been collected from three police stations in order to index the location which requires more attention first. Three methodologies are followed one after another in following sequence firstly data was being refined on basis of "number of accident method", secondly on basis of "accident rate method "and lastly on the basis of "quantum of accident" method. Paper has concluded that fatal accidents are occurring because of improper road geometrics, absence of hazardous lights and vehicles and drivers not following the traffic rules.

Lad et al [13], The accident data has been collected from 2008-12 from Sola high court police stations. On the basis of the data collected 5 black spots are declared. Inventory survey was conducted in which the width of the road, footpath, median, and service lane are measured. Analyses are being carried out using Speed studies, Volume studies and Pedestrian studies. It has been concluded that the accidents are happening because of deficiency in geometric design of road like absence of speed breakers, absence of foot path, improper marking of zebra crossing, non working of traffic signals, and illegal parking of vehicles at intersections. At last no facility was provided to pedestrians to cross the road thus leading to fatal accidents.

Vivek and Saini [14], Data collected on accident has been analyzed on Weighted Severity Index (WSI) method. WSI method used to allocate band score based on severity and number of accidents occurring at that particular location in the last few years. Analysis of the accident has been carried out considering traffic volume count, speed-delay studies. It is concluded that the lane width and condition of road is good but the absence of shoulder is the prime reason causing the fatal accidents. Also the Absence of road marking, guard rail on valley side, road delineator on valley side and improper marking on road are also the reasons for accidents.

Rahman et al. [15], Accident data has been collected from 2002-06 from accident research institute (ARI), BUET Bangladesh. Accident Severity Method and Accident Exposure Method are been used for analysing the data. Comparison has been done between three National highways of Bangladesh i.e. NH-1, NH-2 and NH-5. Analysis has been done considering the factors like type of vehicles involved in accident, different time of the day, location of accidents. Large buses and trucks are responsible for fatal accidents and number of accidents are greater in daylight rather than in night.

Yadav et al. [16], Accident data has been collected from 2009-14 from police station, hospitals lying on NH-44 India. Data collected in form of: Number of road accidents, persons killed/injured on black spots along the NH-44. The data has been analysed considering three parameters Timely variation of accidents, yearly variation of accidents and based on age group. It is concluded that there are poor road geometrics like no separate lane is provided for two wheelers. The author has recommended providing road side speed guns to test the speed of vehicle; intelligent transportation system (ITS) should be deployed.

Kumar et al. [17], has collected data from two sources i.e. from Police station in the form of FIR's and data collected from PWD (2009-14). Five Black spots are been identified out of which three of them lies on T-junction and rest on the intersections. Causes of the accident are over speeding by the vehicles, presence of narrow bridges and absence of pedestrian paths.

## VI. CONCLUSION

India is one of the fastest developing nations in the world, thus resulting in more buying capacity for its citizens. There is a explosion of vehicles on Indian highways which has surged by more than 400% from 2001 to 2013 i.e. in 12 years comparing it to National highway which merely has grown by 133%. Thus resulting in congestion and increase of accident rates in India. Black spots are being declared throughout the country in order to achieve the aim of reduction of accident by 50% till 2020. Middle-income countries own about 52 percent of the world's vehicle but this vehicular group account for more than 88 percent of the world's road traffic fatalities. By this rate of growth the fatal accidents are going to be the 5th largest cause of accident in the world by 2020. Pedestrians and Cyclist and motorbikes together forms around 57 percent of death rates happening on the roads of the world out of which Persons in the age group of 15 to 44 years accounts for more than sixty percent of world's total fatal accident rates. Remedial measures as suggested by WHO are listed down.

Following major Causes of Accidents are being identified by various researchers i.e.

- a. Non-existence of pedestrian and cyclist paths along the road.
- b. Absence of essential road furniture like lane marking, hazardous lights, warning sign boards, delineators on valley side, zebra crossing, speed breakers.
- c. Absence of service lane in the built up areas.
- d. Sub standard road geometrics like absence of shoulders, improper design of horizontal and vertical curves.
- e. Drivers not following the traffic rules.
- f. Overspeeding.

Remedial Measures Suggested:

- a. Use of ITS i.e. Intelligent transportation system e.g. at every 800 meters a digital board should be installed along with speed camera, alternative routes should be provided.
- b. Making and enforcing the strict laws against drunken driving, over speeding, using mobile phone while driving, breaking the traffic rules.
- c. Installation of CCTV cameras along the major highways of the country in order to control the traffic efficiently.
- d. Installation of Speed guns on the expressways and national highways in order to keep the vehicles under the design speeds.
- e. Rigorous design of highways should be carried out and mechanism should be made to ensure the proper design of highways.
- f. Proper road marking should be provided.

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